

Article

Evaluation of Sentinel Lymph Nodes in Complex Atypical Endometrial Hyperplasia

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Abstract: Complex atypical endometrial hyperplasia (CAH) carries a high probability of cancer. The intraoperative evaluation of endometrial cancer in cases of CAH has not been reliable. The safety and sensitivity of sentinel lymph node (SLN) sampling has been validated. In our study, we aimed to evaluate the efficacy and safety of SLN sampling in CAH managed by the da Vinci robotic platform. A total of 113 patients with a preoperative diagnosis of CAH were included in this retrospective cohort study. All of them underwent a robot-assisted total laparoscopic hysterectomy and bilateral salpingo-oophorectomy, with 69 patients undergoing SLN sampling. A statistical analysis calculated the probability of cancer, the SLN map rate, and surgical complications. The predictors of cancer were evaluated. Descriptive statistics were used to summarize the results; comparative statistics were used to compare the cohorts; and logistical regression analysis was used to predict the risk. Forty-seven percent of the entire cohort was diagnosed with endometrial cancer. The median age was 63 years in the SLN cohort (N = 69) and 61 in the No-SLN cohort (N = 44) ($p = 0.363$). The median BMI was 34 Kg/m² in the SLN cohort and 40 in the No-SLN cohort ($p = 0.004$). The bilateral SLN map was 92.8%, and the unilateral SLN map rate was 7.2%. There were no grade-3–4 complications in the SLN cohort, and four grade-3–4 complications in the No-SLN group ($p = 0.021$). A preoperative diagnosis of CAH bordering on or unable to rule out cancer was the only predictor of cancer. Sentinel lymph node sampling has a high map rate and low complications in CAH. We recommend a prospective study investigating the clinical benefit of the procedure.

Keywords: complex atypical hyperplasia; robotic surgery; sentinel lymph node; indocyanine green; endometrial cancer



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1. Introduction

Complex atypical hyperplasia (CAH) of the endometrium is a precursor lesion for endometrial cancer. Up to 42% of cases of CAH diagnosed upon endometrial biopsy are found to harbor endometrial cancer on hysterectomy specimens [1]. Guidelines for the management of complex endometrial hyperplasia lack a clear direction [2], and practice patterns vary from no staging to intraoperative endometrial assessment and conventional lymph node sampling [3–6]. This lack of consistency ultimately results in some endometrial cancer cases being un-staged, undertreated, or overtreated [7].

The American College of Obstetrics and Gynecology Committee currently recommend a total abdominal hysterectomy, with or without bilateral salpingo-oophorectomy, including an option for intraoperative evaluation for the possible staging of an endometrial cancer [2].

Most of these cancers are low risk [8], defined as grade-1–2 endometrioid adenocarcinomas which are less than or equal to 2 cm in size and invade less than or equal to 50% of the myometrium. These cancers have been found to have a low risk of lymph node metastasis and, therefore, do not need staging by lymph node dissection [9,10]. Nevertheless, evaluating these factors by frozen section analysis has been found to lack validity in most institutions, as evidenced by the low accuracy rates reported in various studies [11–13]. This poses a challenge, as the procedure requires time and resources that are not universally available [14].

Sentinel lymph node sampling is now an established staging procedure for endometrial cancer [15] that obviates the need for comprehensive lymph node dissection with its attendant potential morbidity and costs [16–19]. The validity of this technique has now been well documented in large studies [20,21], and an NCCN guideline algorithm exists that informs its use in endometrial cancer [22].

Laparoscopic staging of endometrial cancer by identifying sentinel lymph nodes under near-infrared light after injecting indocyanine green (ICG) dye in the cervix has a high map rate and a negative predictive value, and its safety has been well documented [15,16,20,21].

The use of sentinel lymph node sampling in CAH stems from studies that have demonstrated that up to 10% of cases are classified as high-risk for metastatic disease [1–8], with a risk of lymph node metastasis of 3–7% [8]. Sentinel lymph node sampling in CAH has a high map rate and a negative predictive value, without adding morbidity or surgical time [7,8,23].

The aim of this study was to evaluate the efficacy and safety of sentinel lymph node sampling in cases of complex atypical endometrial hyperplasia, surgically managed by the da Vinci (Intuitive Surgical, Sunnyvale CA) robotic platform using the cervical injection of ICG dye under near-infrared light.

2. Results

One-hundred and thirteen (N = 113) patients were included in this study. Sixty-nine patients underwent sentinel lymph node sampling (SLN), and forty-four did not (No-SLN). The average age in the SLN cohort was 63 years, and, in the No-SLN cohort, it was 61.2 years. The median BMI was significantly lower in the SLN cohort (34.3 Kg/m²) compared to the No-SLN cohort (40.0 Kg/m²) ($p = 0.004$). A total of 26% of the cohort had diabetes mellitus, 65% had hypertension, and 34% had hyperlipidemia with no statistical difference between the two sub-cohorts. Most patients had an ASA grade of 2–3, with no statistical difference between the two cohorts (Table 1).

Table 1. Patient characteristics.

Variable	SLN N = 69	No-SLN N = 44	Total N = 113	<i>p</i> -Value
Median Age (Q1–Q3)—Years	63 [57–70]	61 [53–67.25]	62 [56–69]	0.363
Median BMI (Q1–Q3)—Kg/m ²	34 [30.0–38.6]	40.0 [33.7–44.0]	36.3 [31.7–41.0]	0.004
Diabetes Mellitus	16 (23.2%)	14 (31.8%)	30 (26.5%)	0.427
Hypertension	44 (63.8%)	30 (68.2%)	74 (65.5%)	0.781
Hyperlipidemia	21 (30.4%)	18 (40.9%)	39 (34.5%)	0.348
ASA Grade				0.789
1	1 (1.4%)	0 (0%)	1 (0.9%)	
2	30 (43.5%)	16 (36.4%)	46 (40.7%)	
3	37 (53.6%)	28 (63.6%)	65 (57.5%)	
4	1 (1.4%)	0 (0%)	1 (0.9%)	

SLN: sentinel lymph node; and ASA: American Society of Anesthesiologists' classification. Student's *t*-test performed for analysis.

Table 2 summarizes the histopathological variables of our cohort. Sixty-three (55.8%) patients had their diagnosis through hysteroscopy dilation and curettage, and fifty (44%) patients were diagnosed by endometrial biopsy ($p = 0.44$). Thirty-nine (34.5%) patients were diagnosed with complex atypical hyperplasia of the endometrium either bordering on endometrial cancer or unable to rule out endometrial cancer (CAH/EAC): 24 (34.8%) in the SLN cohort and 15 (34.1%) in the No-SLN cohort ($p = 1.00$). Fifty-two (46%) patients were diagnosed with endometrial cancer upon the final pathology: thirty-two (46.4%) in the SLN cohort and twenty (45.5%) in the No-SLN cohort ($p = 0.215$).

Table 2. Histopathological data.

Variable	SLN N = 69	No-SLN N = 44	Total N = 113	p-Value
Preop. Diagnosis				1.000
CAH	45 (65.2%)	29 (65.9%)	74 (65.5%)	
CAH/EAC	24 (34.8%)	15 (34.1%)	39 (34.5%)	
Postop. Diagnosis				0.215
No hyperplasia	9 (13%)	11 (25%)	20 (17.7%)	
CAH	28 (40.6%)	13 (29.5%)	41 (36.3%)	
EAC	32 (46.4%)	20 (45.5%)	52 (46%)	
Biopsy Method				0.444
EMB	33 (47.8%)	17 (38.6%)	50 (44.2%)	
D&C	36 (52.2%)	27 (61.4%)	63 (55.8%)	

SLN: sentinel lymph node; CAH: complex atypical hyperplasia; CAH/EAC: complex atypical hyperplasia bordering on cancer or unable to rule out cancer; Preop.: preoperative; and Postop.: postoperative. Chi-square analysis performed.

Table 3 describes the characteristics of the patients with endometrial cancer. Fifty-two (46%) patients were diagnosed with endometrial cancer during a postoperative histopathological analysis: thirty-two of them were in the SLN cohort, and twenty were in the No-SLN cohort (Table 3). All the patients had an endometrioid histopathology, and there were no cases of uterine carcinosarcoma, uterine serous cancer, or clear-cell carcinoma of the endometrium. Fifty (96.2%) patients had a disease of FIGO grade 1 or 2, and two (3.8%) had a grade-3 disease. There was no statistical difference between the two cohorts.

Thirty-six (69%) patients were diagnosed with stage 1A cancer, and fifteen (28.8%) had stage 1B. There was no statistical difference between the two cohorts. Only one patient in the SLN cohort had stage II cancer. One patient with stage IB disease had positive isolated tumor cell (ITC) LN metastasis. According to the consensus guidelines [15], this did not up-stage the patient to stage III C1, and the patient was treated with adjuvant brachytherapy to the vaginal cuff following the NCCN guidelines [22] for the treatment of stage IB disease (Table 3).

Thirty-six (69.2%) patients had a depth of invasion less than or equal to 50%, and sixteen (30.8%) patients had a depth of invasion of more than 50%. There was no statistical difference between the two cohorts. The size of the tumor was less than or equal to 2 cm in 19 (36.5%) patients, and more than 2 cm in 27 (51.9%) patients. The size of the tumor was not determined in six (11.5%) patients. There was no statistical difference between the two cohorts. Lymphovascular space invasion was reported in three (5.8%) patients in the SLN cohort. Peritoneal cytology was not reported to be positive for malignant cells in any patient (Table 3). There was no statistical difference between the two cohorts regarding the preoperative diagnosis or the biopsy method, with 29 (55.8%) patients diagnosed with complex atypical hyperplasia bordering on or unable to rule out cancer (CAH/EAC), and 26 (50%) patients diagnosed by curettage (D&C) (Table 3).

Twenty seven out of fifty-two patients with cancer did not meet the low-risk Mayo Clinic criteria (grade 1–2; less than or equal to 2 cm in the greatest diameter and a depth of myometrial invasion less than or equal to 50%). These patients comprised 23.8% of the entire cohort and would have required lymph node assessment [9,10].

Table 3. Characteristics of patients with endometrial cancer (N = 52).

Variable Number (%)	SLN N = 32	No-SLN N = 20	Total N = 52	p-Value
EAC Grade				
1/2	30 (93.7%)	20 (100.0%)	50 (96.2%)	0.517
3	2 (6.3%)	0 (0.0%)	2 (3.8%)	
Stage				
IA	20 (62.5%)	16 (80.0%)	36 (69.2%)	0.427
IB	11 (34.4%)	4 (20.0%)	15 (28.8%)	
II	1 (3.1%)	0 (0%)	1 (1.9%)	
DOI				
<or equal to 50%	20 (62.5%)	16 (80.0%)	36 (69.2%)	0.307
>50%	12 (37.5%)	4 (20.0%)	16 (30.8%)	
Size				
(not specified %)	3 (9.3%)	3 (15%)	6 (11.5%)	0.767
<or equal to 2 CM	11 (34.3%)	8 (40%)	19 (36.5%)	
>2 CM	18 (56.2%)	9 (45%)	27 (51.9%)	
LVI				
ABSENT	29 (90.6%)	20 (100%)	49 (94.2%)	0.276
PRESENT	3 (9.4%)	0 (0%)	3 (5.8%)	
Cytology				1.000 **
NEGATIVE	25 (78.1%)	19 (95.0%)	44 (84.6%)	0.132 ***
POSITIVE	0 (0%)	0 (0%)	0 (0%)	
Missing data	7 (21.9%)	1 (5.0%)	8 (15.4%)	
Preop. Diagnosis				
CAH	13 (40.6%)	10 (50%)	23 (44.2%)	0.707
CAH/EAC	19 (59.4%)	10 (50%)	29 (55.8%)	
Biopsy Method				
EMB	16 (50%)	10 (50%)	26 (50%)	1.000
D&C	16 (50%)	10 (50%)	26 (50%)	

SLN: sentinel lymph node; EAC: endometrioid adenocarcinoma; DOI: depth of invasion; LVI: lymphovascular space invasion; CAH: complex atypical hyperplasia; and CAH/EAC: complex atypical hyperplasia bordering on endometrial cancer or unable to rule out cancer. Notes: **: The *p*-value is for the distribution of “NEGATIVE” vs. “POSITIVE”. The percentages are based on “NEGATIVE”, “POSITIVE”, and “Missing data”. ***: The *p*-value is for the distribution of “NEGATIVE” vs. “Missing data”. The percentages are based on “NEGATIVE”, “POSITIVE”, and “Missing data”. Chi-square analysis performed.

Upon multivariate analysis, only a preoperative histology (complex atypical hyperplasia bordering on or unable to rule out cancer (CAH/EAC) vs. complex atypical hyperplasia (CAH)) was found to be a significant predictor of cancer ($p < 0.001$). Age, BMI, diabetes mellitus, hypertension, hyperlipidemia, and the biopsy method did not predict cancer in our model (Appendix A).

Thirty-nine (34.5%) patients were diagnosed with CAH bordering on EAC (CAH/EAC) preoperatively. Twenty-nine out of thirty-nine patients (74.3%) were diagnosed with cancer postoperatively, versus twenty-three out of seventy-four (31%) in those who had been preoperatively diagnosed with CAH ($p < 0.001$) (Table 3). There was no statistical difference between these two subgroups regarding age, BMI, diabetes mellitus, hypertension, hyperlipidemia, biopsy method, postoperative grade or stage, size of the tumor, or depth of invasion (Appendix B). Multiple logistic regression analyses using the same variables demonstrated no significant difference between the two subgroups (Appendix C).

Bilateral mapping to the sentinel lymph nodes (Table 4) was achieved in 64 (92.8%) of the 69 patients in the SLN cohort, while unilateral mapping was achieved in the remaining 5 (7.2%) patients. A lymph node was recovered from both hemi-pelvises in 63/64 bilaterally mapped patients and from all the patients that had been mapped unilaterally (Table 4). Pelvic lymph node dissection was performed in four patients in the SLN cohort and four patients in the No-SLN cohort, while para-aortic lymph node dissection was performed in

one patient in the No-SLN cohort. A lymph node was reported to be positive for isolated tumor cell (ITC) LN in one patient in the SLN cohort (Table 4).

Table 4. Lymph node data (N = 113).

Variable	Value	SLN N = 69	No-SLN N = 44	Total N = 113	p-Value
Mapping	No	0 (0%)	44 (100%)	44 (38.9%)	<0.001
	Unilateral	5 (7.2%)	0 (0%)	5 (4.4%)	
	Bilateral	64 (92.8%)	0 (0%)	64 (56.6%)	
SLNB	No	1 (1.4%)	44 (100%)	45 (39.8%)	<0.001
	Unilateral	6 (8.7%)	0 (0%)	6 (5.3%)	
	Bilateral	62 (89.9%)	0 (0%)	2 (54.9%)	
PLND	No	65 (94.2%)	40 (90.9%)	105 (92.9%)	0.844
	Unilateral	3 (4.3%)	3 (6.8%)	6 (5.3%)	
	Bilateral	1 (1.4%)	1 (2.3%)	2 (1.8%)	
PALND	No	69 (100%)	43 (97.7%)	112 (99.1%)	0.389
	Yes	0 (0%)	1 (2.3%)	1 (0.9%)	
Cytology	Negative	56 (81.2%)	43 (97.7%)	99 (87.6%)	1.000 *
	Positive	0 (0%)	0 (0%)	0 (0%)	
	N/A	13 (18.8%)	1 (2.3%)	14 (12.4%)	

Notes: *: The *p*-value is for the distribution of “0” vs. “1”. The percentages are based on “0”, “1”, and “N/A”. Chi-square analysis performed.

The operative findings are summarized in Table 5. The mean operative time was 148.8 min in the SLN cohort and 144.3 min in the No-SLN cohort ($p = 0.918$). The mean estimated blood loss was 92 milliliters in the SLN cohort and 109 milliliters in the No-SLN cohort ($p = 0.009$). There was no conversion to laparotomy. Grade 3 or 4 Clavien–Dindo rated complications [24,25] were reported in no patients in the SLN cohort and in four (9%) patients in the No-SLN cohort ($p = 0.021$), with three patients with grade-3 and one patient with grade-4 complications (Table 5). A detailed narrative of these complications is provided in Appendix D.

Table 5. Operative data.

Variable	SLN N = 69	No-SLN N = 44	Total N = 113	p-Value
Mean LOS (SD)—min	148.8 (58.2)	144.3 (38.4)	147 (51.2)	0.918
Mean EBL (SD)—mL	91.9 (87.9)	109.1 (55.0)	98.6 (77.0)	0.009
Complication Grade 3/4 [§]	0 (0%)	4 (9.1%)	4 (3.5%)	
Bowel perforation/fistula	0	2	2	0.021
Vaginal cuff dehiscence	0	1	1	
Wound infection	0	1	1	

SD: standard deviation; SLN: sentinel lymph node; LOS: length of surgery; EBL: estimated blood loss; [§] Clavien–Dindo classification system of complications [26,27]; and mL: milliliters. Student’s *t*-test performed to analyze the mean LOS and EBL. Chi-square analysis performed to analyze the complications.

3. Discussion

In this single-institution retrospective cohort study, the prevalence of endometrial cancer in patients with a preoperative diagnosis of CAH was 46%. Most of the patients with cancer had a low-grade disease. All of them had an early-stage disease, but 23.8% met the Mayo criteria for lymph node dissection. When sentinel lymph node sampling was attempted, bilateral mapping was achieved in 92.8% of the patients, and unilateral mapping was achieved in 7.2%. Sentinel lymph node sampling was not associated with additional complications.

SLN evaluation has become a widely adopted technique for endometrial cancer staging due to its safety and high sensitivity in detecting lymph node metastasis when combined with ultra-staging using immunohistochemistry [20,21,26,27], and an NCCN algorithm is

a sanctioned standard of care in its management [22,28]. SLN mapping using a cervical injection of ICG dye under near-infrared light has shown an improved sensitivity and a negative predictive value [16,20,21], and, although the technology is available in different platforms, it is safe to assume that most gynecological oncologists in the United States are currently well trained to perform the procedure expeditiously and safely using the da Vinci (Intuitive Surgical, Sunnyvale CA) robotic platform [7,20,29,30].

Given that the risk of endometrial cancer is up to 42% [1] in patients with a preoperative diagnosis of CAH, investigators have begun to study sentinel lymph node sampling in the management of such patients [5,7,8]. The necessity for this research has stemmed from the fact that the sensitivity of a preoperative biopsy in the diagnosis of cancer is low, with a high rate of inter- and intra-observer variability in the largest prospective GOG trial [1,31]. The intraoperative diagnosis of cancer by frozen-section analysis has been reported in studies as an effective method [9,32]; however, this technique has not been shown to be reliable outside of a few centers with dedicated personnel, time, and resources [11–14]. Additionally, sentinel lymph node sampling performed after a hysterectomy has severed the uterine lymphatics is technically challenging.

It is true, however, that the prevalence of high-intermediate-risk cancer or high-risk cancer in this population is about 10% [1,8], and the incidence of lymph node metastasis is about 3–7% [8]. Although identifying these patients would inform adjuvant treatment and prevent either reoperation or overtreatment with radiation therapy [33,34], a surgical technique that benefits such a relatively small number of patients must have an equally low risk of complications.

Retrospective studies on the use of SLNS in CAH have consistently reported a low complication rate [7,35]. In our study, we used a validated surgical complication score [24,25] and found no morbidity of grade 3 or 4 associated with SLNS. Indeed, all four of our grade-3–4 complications were in the No-SLN cohort, likely reflecting the statistically unbalanced nature of our retrospective cohort, where patients with a higher BMI and more comorbidities did not undergo SLNS.

As mentioned above, our study is limited by its retrospective nature and, hence, the selection bias inherent to our analysis. The small sample size allowed for a limited multiple logistic regression analysis model, which, consistent with the findings by Touhami et al. [5], identified a preoperative diagnosis of complex atypical hyperplasia unable to rule out or bordering on cancer (CAH/EAC) as a significant predictive factor of a postoperative diagnosis of cancer. Furthermore, since this study focused on robot-assisted sentinel lymph node mapping using ICG dye under a near-infrared light, our results cannot be generalized to populations that are not managed using this technique.

However, we did not evaluate the contribution of other predictive factors such as preoperative endometrial thickness, which was found to predict cancer in cases where an endometrial thickness of ≥ 15 mm was associated with a 1.5-time risk of cancer and a 2.5-time risk of meeting the Mayo Clinic criteria for lymph node dissection [36,37]. Furthermore, Laskov et al. [38] reported on a study with 79 patients with CAH, in whom CAH in a polyp was associated with significantly less incidence of not only cancer but also higher-grade end stage disease [38]. Including as many relevant factors as possible in a preoperative algorithm to instruct the most efficient management policy is certainly warranted.

Another possible selection bias that appeared in our study is the significantly higher BMI in the patients in the No-SLN cohort. This most likely reflects the surgeon's reluctance to perform a procedure whose risk may outweigh its benefit. Kogan et al. [39] reported on 223 obese (median BMI 40.6 Kg/m²) patients with endometrial cancer, in whom SLN sampling was not associated with a difference in the overall survival or progression-free survival, while being associated with a significant increase in operative time and blood loss, although the clinical significance of the small change reported is unclear. Whether obesity is a risk factor for unsuccessful SLN mapping is controversial in the literature [40,41].

Nevertheless, the current study elucidated the low sensitivity of preoperative sampling, whether by endometrial biopsy or curettage, to diagnose cancer in contradistinction

to the high reliability and safety of performing sentinel lymph node sampling in this population, where 10–28% of patients met the criteria for lymph node dissection [8,36].

In conclusion, given the low risk of SLNS, we support a prospective study into its clinical benefit in patients with a preoperative diagnosis of CAH. As conceptualized by others, such a study should include a preoperative radiological [37] histopathological [5,38] and molecular [7] classification algorithm of specimens to further the diagnosis and inform the management of this entity.

4. Materials and Methods

This was a retrospective cohort study conducted between December 2016 and March 2023 after obtaining Institutional Review Board I (IRB) approval [number 201,504,071 J]. This study included all the patients between 18 and 90 years of age with complex atypical endometrial hyperplasia diagnosed during a preoperative biopsy or a dilation and curettage sample and managed surgically using the da Vinci (Intuitive Surgical, Sunnyvale CA) robotic platform. The authors excluded all the patients with hyperplasia of the endometrium without atypia.

This cohort was treated by two surgeons at our institution. All the patients underwent a robot (da Vinci platform, Sunnyvale, CA, USA)-assisted total laparoscopic hysterectomy and bilateral salpingo-oophorectomy. Sentinel lymph node sampling was conducted when feasible or when deemed necessary by the surgeon based on their interpretation of the preoperative histopathological findings. Complex atypical hyperplasia of the endometrium bordering on endometrial cancer or unable to rule out endometrial cancer (CAH/EAC) was an indication for sentinel lymph node sampling unless contraindicated by other variables such as morbid obesity, serious comorbidities such as coagulopathy or heart disease, or, in some cases, a lack of mapping under near-infrared light after the injection of indocyanine green (ICG) dye in the cervix. The da Vinci platform-mounted near-infrared light camera was used for the identification of sentinel lymph nodes, and ICG dye (0.5 mg/mL) was injected in the cervix in the standard manner reported previously at 3 o'clock and 9 o'clock, 2 mm deep and 1 cm deep [24]. The National Comprehensive Cancer Network (NCCN) [22] algorithm for sentinel lymph node sampling in endometrial cancer was followed in most cases undergoing SLN dissection. If mapping for SLN was negative in one hemi-pelvis, then a systematic lymph node dissection of this hemi-pelvis was performed [22], unless the risk was deemed to outweigh the benefit. Additionally, the excision of suspicious lymph nodes and para-aortic lymph node dissection were performed at the surgeon's discretion. An intraoperative frozen section analysis was inconsistently used, and the findings shall not be reported in this analysis.

The numerical variables were summarized using the median and interquartile range [first quartile–third quartile]. The categorical variables were summarized using frequencies and percentage. To compare the cohorts, Student's t-test or Wilcoxon's Rank Sum test was used for the numerical variables as appropriate. The chi-square test or Fisher's exact test was used for the categorical variables, based on the sample size. Multiple logistic regression analysis was used to assess the chance of having cancer with the variables of interest. The two-sided *p* value was reported for each test. A *p* value less than 0.05 was considered an indication of statistical significance. Statistical analysis was performed using the R language [42].

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Informed Consent Statement: Patient consent was waived due to the retrospective nature of this study and the fact that it presents no risk to the subjects.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy reasons.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Patients with endometrial cancer stratified by preoperative diagnosis (N = 52).

Variable	CAH (N = 23)	CAH/EAC (N = 29)	p Value
Median Age (Q1–Q3)—Years	64.7 (10.0)	61.6 (11.6)	0.312
Median BMI (Q1–Q3)—Kg/m ²	36.3 (6.5)	38.1 (7.4)	0.357
DM			
No	16 (69.6%)	18 (62.1%)	0.786
Yes	7 (30.4%)	11 (37.9%)	
HTN			
No	4 (17.4%)	11 (37.9%)	0.188
Yes	19 (82.6%)	18 (62.1%)	
HPL			
No	15 (65.2%)	17 (58.6%)	0.843
Yes	8 (34.8%)	12 (41.4%)	
ASA			
I	NA	NA	0.648
II	8 (34.8%)	10 (34.5%)	
III	14 (60.9%)	19 (65.5%)	
IV	1 (4.3%)	0 (0%)	
Biopsy Method			
EMB	11 (47.8%)	15 (51.7%)	1.000
D&C	12 (52.2%)	14 (48.3%)	
Any LND (SLNB OR PLD OR PPALND)			
No	9 (39.1%)	9 (31.0%)	0.752
Yes	14 (60.9%)	20 (69.0%)	
Grade			
I	17 (73.9%)	21 (72.4%)	1.000
II	5 (21.7%)	7 (24.1%)	
III	1 (4.3%)	1 (3.4%)	
Stage			
IA	16 (69.6%)	20 (69.0%)	0.740
IB	6 (26.1%)	9 (31.0%)	
II	1 (4.3%)	0 (0.0%)	
DOI			
<50%	16 (69.6%)	20 (69.0%)	1.000
>OR EQUAL TO 50%	7 (30.4%)	9 (31.0%)	
Size			
(not specified %)	5 (21.7%)	1 (3.4%)	0.513
<2 CM	9 (39.1%)	10 (34.5%)	
>OR EQUAL TO 2 CM	9 (39.1%)	18 (62.1%)	
LVI			
No	22 (95.7%)	27 (93.1%)	1.000
Yes	1 (4.3%)	2 (6.9%)	

ASA: American Society of Anesthesiologists' classification; BMI: body mass index; DM: diabetes mellitus; HTN: hypertension; HPL: hyperlipidemia; DOI: depth of invasion; SLN: sentinel lymph node; EAC: endometrioid adenocarcinoma; LVI: lymphovascular space invasion; CAH: complex atypical hyperplasia; and CAH/EAC: complex atypical hyperplasia bordering on endometrial cancer or unable to rule out cancer.

Appendix B

Table A2. Multiple logistic regression. Predictors of endometrial cancer.

Risk Factor	Standard Error		p Value
Age	0.023	0.023	0.3
BMI	0.013	0.03	0.66
Diabetes	0.344	0.524	0.51
Hypertension	0.636	0.511	0.21
Hyperlipidemia	−0.121	0.478	0.8
Preop. Diagnosis	1.99	0.484	0.001
Biopsy Method	−0.436	0.44	0.32

Appendix C

Table A3. Simple logistical regression. Preoperative diagnosis of CAH vs. CAH/EAC.

Variable	p-Value
AGE	0.532
BMI	0.338
DM	0.076
HTN	0.243
HLD	0.416
Biopsy Method	0.257
Postop. Grade	0.813
Postop. Size	0.422
DOI	0.813
LVI	0.984
Stage	0.813

BMI: body mass index; DM: diabetes mellitus; HTN: hypertension; HPL: hyperlipidemia; DOI: depth of invasion; EAC: endometrioid adenocarcinoma; LVI: lymphovascular space invasion; CAH: complex atypical hyperplasia; and CAH/EAC: complex atypical hyperplasia bordering on endometrial cancer or unable to rule out cancer.

Appendix D. Narrative Description of Postoperative Complications (N = 4)

One 90-year-old patient in the No-SLN cohort with a history of extensive diverticular disease underwent reoperation, sigmoid colectomy, and colostomy 10 days after a full robotic hysterectomy and bilateral salpingo-oophorectomy for a ruptured diverticular abscess. Another 62-year-old patient with a BMI of 40 and severe diverticular disease encountered during the operation underwent primary bladder repair and sigmoid serosal repair by colorectal surgery service during the robotic hysterectomy; however, they developed a colo-vesical fistula 3 months later, requiring a low anterior resection and anastomosis.

A 46-year-old patient with a BMI of 36.6, diabetes mellitus, renal failure, and chronic anticoagulation developed vaginal cuff bleeding and dehiscence, requiring repair in the operating room two weeks after her robotic surgery.

And, finally, a 59-year-old patient with a BMI of 33 developed an incisional site infection necessitating incision and drainage in the operating room about 10 days after her robotic surgery.

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